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Research Shows Benefits of Pavement Preservation Techniques

The costs of building new roads continue to rise, and, as a result, ways to extend pavement life are becoming increasingly important. Innovative pavement preservation techniques offer tools for the effective and cost-efficient management of the pavement life cycle.

MnROAD

MnROAD Contributions

In 1994, the Minnesota Department of Transportation opened the Minnesota Road Research Project—better known as MnROAD—one of the most sophisticated, independently operated pavement test facilities in the world. Its design incorporates thousands of electronic in-ground sensors and an extensive data collection system for studying how traffic loadings and environmental conditions affect pavement materials and performance over time.

Throughout the years, the MnROAD facility has helped researchers evaluate many conventional and innovative treatments on concrete and asphalt pavements for both high-volume and low-volume traffic. The following summaries of selected pavement preservation techniques highlight the findings from a variety of research projects at MnROAD.

Optimal Timing of the Placement of Surface Treatments

Pooled-fund study TPF-5 (153) explores how pavement preservation treatments can inhibit aging and improve the performance of asphalt pavements. The Minnesota Local Road Research Board (LRRB) and the Maryland, Minnesota, Ohio, Texas, and Wisconsin Departments of Transportation are contributors. Researchers from the Asphalt Institute are evaluating surface treatments applied to MnROAD subsections throughout the pavement life—from immediately behind the paver to successive years—and taking field cores to determine the material properties, especially related to aging. Monitoring and distress surveys will link preservation to performance.

Microsurfacing

Five MnROAD maintenance projects have helped demonstrate advancements in traditional and flexible microsurfacing. The research began with a single test cell in 1999.

In 2003, as part of a study on restoring ride quality, researchers explored the benefits of different crack-repair techniques prior to microsurfacing treatment. A matrix of 12 test cells received crack resealing, leveling of cupped transverse cracks, filling of rutted wheel paths, and control treatments. According to findings, two-lift crack repairs provided the longest effect on ride.

In a 2006 study, researchers treated four cells with PG grade 48-34 microsurfacing to provide a mix rigid enough for rut filling but also flexible enough to inhibit low-temperature cracking. The treatments showed promising results and led to a 2012 microsurfacing project with Kraton that used high-polymer modified emulsion on an interstate test cell. Results are showing that use of softer -34C base asphalt enhances the performance of microsurfacing in colder northern-climate states.

MnROAD Up Close

The MnROAD facility, adjacent to Interstate 94 near the Twin Cities, features two separate roadway segments that contain more than 50 distinct test cells. Each cell, approximately 500 feet long, consists of different combinations of surface materials, aggregate bases, and subgrades, as well as variations in structural design and drainage features.

A 3.5-mile, two-lane interstate mainline carries live I-94 traffic, averaging 26,500 vehicles per day, including 13 percent trucks. This equals 750,000 flexible and 1 million rigid equivalent single-axle loads (ESALs) per year.

A 2.5-mile, two-lane, closed-loop low-volume road (LVR) is loaded by one 18-wheel, five-axle tractor-trailer averaging 70 laps per day in the outside lane.

Planning for the next phase of MnROAD for 2016 construction is beginning this year, and pavement preservation will be a major focus.

Lane-Shoulder Sealing Effectiveness

Researchers studied concrete test sections with hot-mix asphalt (HMA) shoulders and longitudinal edge drains before and after sealing the lane-shoulder edge joints. Sealing the edge joint reduced the total volume of water entering the pavement drainage system by as much as 85 percent. It also slowed deterioration of the asphalt shoulder, reducing the tendency toward shoulder drop-off.

Asphalt Longitudinal Joint Protection

In 2009, researchers applied longitudinal centerline cold joint-treatment products, Diluted CSS-1h, and JOINTBOND®, at various rates to new asphalt overlays on the MnROAD mainline and low-volume road (LVR). Field performance monitoring and permeability testing continues.

Thin Warm-Mix Asphalt Overlay

Mill-and-fill is a commonly used repair in Minnesota. Study of a warm-mix asphalt (WMA) overlay at MnROAD revealed that lower plant temperatures for WMA may help extend pavement life by slowing the aging process.

In 2008, researchers at MnROAD placed a WMA overlay on an original MnROAD interstate cell that had poor ride, severe top-down cracking, and transverse cracking every 20 feet. They milled 3 inches and placed 4 inches of WMA. The WMA modifier assisted the contractor in achieving compaction. Only 40 percent of the cracking returned after four years of interstate service.

Full-Depth Concrete Joint Repairs

Poor performance of current patching techniques for full-depth joint repairs—grouting or epoxying dowel bars into existing pavement—prompted a controlled, full-scale experiment at MnROAD with industry participation. Preliminary findings show that grout capsules or bags result in the best anchorage of dowel bars.

In 2010 and 2013, researchers constructed several full-depth joint repairs on thin test cells. They installed varying numbers of plate dowels in partnership with PNA Construction Technologies across joints to provide load transfer between the patch material and the existing slab. To date, installations with a minimum of six plate dowels across a 12-foot-wide lane have performed very well.

For More Information

For more information about the research in this fact sheet, please contact:

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More about TERRA, including contact information for program representatives **Stephanie Malinoff** (Center for Transportation Studies) and **Maureen Jensen** (Minnesota Department of Transportation), is online at www.TerraRoadAlliance.org.

Resources

- For reports and other summaries on MnROAD research, visit www.dot.state.mn.us/mnroad/reports.
- For information on current MnROAD projects, visit www.dot.state.mn.us/mnroad/projects/newindex.html.

Links to these resources are at www.TerraRoadAlliance.org.

Partial-Depth Concrete Repairs

Working with manufacturers, researchers at MnROAD used 13 different types of patching materials to repair several different mainline concrete test sections in September 2011. Based on evaluation after one winter, emulsion-based products did not perform as well as the cement- and epoxy-based products. Monitoring continues until 2016.

PCC Diamond Grinding

A pooled-fund study with Texas DOT, the Federal Highway Administration (FHWA), Diamond Surfacing Inc., and the International Grooving and Grinding Association (IGGA) helped address increasing public concerns about pavement noise and led to the development of the Next Generation Concrete Surface (NGCS), also known as innovative diamond grinding. Tests at MnROAD have contributed to many recent innovations in diamond grinding techniques that have been implemented in Minnesota and other states (see the TERRA fact sheet *Quiet, Safe, and Smooth Concrete Pavements*). NGCS made history as the first new concrete pavement texture to be introduced in the last several decades and as the quietest texture yet developed for non-porous portland cement concrete (PCC) pavements. NGCS produces a consistent surface without positive or upwardly spiked texture, which leads to a substantial reduction in sound. MnROAD testing also demonstrated successful grinding of pervious concrete pavements in October 2013.

Ultra-Thin Bonded Wearing Coarse (UTBWC) with SFDR

Researchers at MnROAD constructed two stabilized full-depth reclamation (SDFR) sections in partnership with Road Science on the I-94 mainline in 2008. The sections have allowed researchers to study the performance of full-depth reclaimed pavements that were stabilized with engineered emulsion over time. Surfacing consisted of a 2-inch Superpave mix and a three-quarter-inch ultra-thin bonded wearing course (NovaChip). After five years of high volume traffic, the UTBWC is performing well with very little cracking.

Thin Bonded Concrete Overlays of Asphalt Pavement

Researchers at MnROAD successfully completed four major efforts to provide data for the development of a rational design procedure (BCOA–ME) for bonded concrete overlays of asphalt pavements, also known as whitetopping. The researchers built six test cells in 1997, four test cells in 2004, nine test cells in 2008, and four more in 2013 on the I-94 mainline. Each effort demonstrated that smaller panels with sealed joints perform the best under the high-traffic loads.